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(54) [Title of the Invention]

COATING MATERIAL FOR A REFRactory MATERIAL
 AND METHOD FOR ITS APPLICATION

(57) [Abstract]

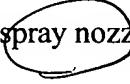
[Objective] To provide a coating material that can effectively prevent the fusion of pottery and ceramics with refractory siliceous material and that will not peel off easily during the firing process.

[Solution] The material provided is a coating material for a refractory material

to be used for coating the surface of a silicon carbide siliceous refractory material, characterized in that it contains mullite and alumina powder as its main constituents, in that the thickness of the applied coating is in the range of 0.1-1.0 mm, and in that the surface has certain unevenness with 10-point average roughness in the range of 40-500 µm. The present invention also pertains to a repetitive coating method involving spraying the coating material from a spray nozzle onto a silicon carbide siliceous material that has been heated to 50-200°C.

[Scope of the Patent Claims]

[Claim 1] Coating material for a refractory material, characterized in that it is a coating material for coating the surface of a silicon carbide siliceous refractory material, in that its composition includes mullite and alumina powder as the main constituents, in that the thickness of the applied coating is in the range of 0.1-1.0 mm, and in that its surface has a certain unevenness with 10-point average roughness in the range of 40-500 µm.

[Claim 2] Method for applying a coating material, characterized in that, in the method for coating a refractory material with the coating material described in Claim 1, the coating material is sprayed from a ~~the spray~~  onto a silicon carbide siliceous refractory material that has been heated to a temperature in the range of 50-200°C.

[Detailed Description of the Invention]

[0001]

[Areas of Industrial Application] The present invention pertains to a coating agent for a silicon carbide siliceous refractory material that can be used in the process of firing pottery and ceramics and a method for its production and application.

[0002]

[Conventional Technology] Silicon carbide siliceous refractory materials are typically known for their excellent refractoriness, heat resistance, and heat impact resistance [*We're tempted to use "thermal shock resistance", but the Japanese characters for it are slightly different -- Tr. Ed.*] and are widely used, for example, as shelves in the firing of pottery and ceramics. However, silicon carbide siliceous refractory materials can react with the oxygen in the atmosphere during their use to form silicate compounds, and thus can also react with the products being fired causing mutual fusion. This problem can clearly reduce the product yield.

[0003]

[Problems to be Solved by the Invention] In order to prevent the fusion problem mentioned above, the surface of the silicon carbide siliceous refractory material, in general, can be coated with a material that contains mullite and alumina powder as its main constituents to prevent the silicon carbide siliceous refractory material from reacting with the products being fired. A brush or a sprayer is generally used to apply the coating material, which is typically in the form of a slurry, on the surface of the refractory material at normal temperature. For example, it has been proposed to use the coating material described in Japanese Patent Publication No. 4 [1992]-59,276 for coating the surface of a refractory material. In this process, it is necessary to limit the grain size, type, and contents of mullite and alumina powder in the coating material. With this procedure, however, if the coating material is being coated in a thickness greater than 0.1 mm, the coating material itself will readily undergo sintering contraction during its use and thus detachment of the coating material will occur easily when the product is used.

For a coating thickness of about 0.1 mm, the fusion-preventing effect is minor and it is necessary to repeat the coating process after the coated product has been used several times. Furthermore, the pottery and ceramics to be fired will frequently undergo firing contraction during the firing process. Thus, in order to prevent sliding on the surface of a silicon carbide siliceous refractory material caused by contraction of the to-be-fired material, it is necessary to apply a covering powder on the applied coating material. On the other hand, when the refractory material used consists of an alumina base material or a mullite base material, it has been proposed to use the method described in Japanese Opened Patent No. 5 [1993]-270,925 in which the surface of the base material is coated with stable zirconia having an average particle size in the range of 5-100 µm in a thickness in the range of 40-200 µm or to use a method in which the surface of the base material having a coating layer is made so as to provide surface roughness in the range of 15-100 µm in order to prevent peeling. In the case of the silicon carbide siliceous refractory material used in the present invention, however, the methods described above are not suitable from the standpoint of preventing of the coating layer and the to-be-fired material from mutually reacting

[0004]

[Approach to Solving the Problems] The purpose of the present invention is to reduce and/or eliminate the aforementioned shortcomings by coating the surface of the silicon carbide siliceous refractory material. Moreover, the coating agent itself causes the appearance of unevenness on the surface of the refractory material so as to prevent contraction sliding of the to-be-fired material. The coating material for a refractory material is characterized in that it contains mullite and alumina powder as its main

constituents, in that the coating thickness is in the range of 0.1-1.0 mm, and in that the surface has a certain unevenness with 10-point average roughness in the range of 40-500 μm . The present invention also pertains to a method involving repeated application of the coating agent by spraying the coating agent from a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material which has been heated to a temperature in the range of 50-200°C.

[0005]

[Function] The coating material of the present invention is a coating material for a refractory material, characterized in that it contains mullite and alumina powder as its main constituents, in that the coating thickness is in the range of 0.1-1.0 mm, and in that the surface has a certain unevenness of 40-500 μm . The present invention also pertains to a method involving repeated application of the coating agent by spraying the coating material from a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material which has been heated to a temperature in the range of 50-200°C. This coating material enhances the effect of preventing the reaction and fusion mentioned above by forming a thick layer of the mullite and alumina powder main constituents on the surface of the refractory material. At the same time, the unevenness appearing on the surface helps to prevent contraction sliding of to-be-fired material during the firing process. Moreover, as mentioned above, by applying the coating material while heating the silicon carbide siliceous refractory material, unevenness will appear on the surface of the coating material regardless of the grain size of the raw material used in producing the coating material. In this way, sintering contraction of the coating material itself will occur to only a very limited extent during its use and it will become unnecessary to

restrict the grain size, type, and contents of mullite and alumina powders in the coating agent during the application process. Moreover, an organic binder of the vinyl alcohol type and the cellulose type as well as the wax emulsion type may be used concomitantly to improve the water resistance of the coating material before its use and to make it easy to store the refractory material after the application of the coating material. If desirable, layers of a different coating agent may be applied on the aforementioned coating agent to further enhance the coating effect. The coating material used is not limited to mullite and alumina, e.g., zirconia, boron nitride, etc., may also be used. Moreover, the coating material of the present invention can be applied not only on silicon carbide siliceous refractory materials but also on silicon nitride siliceous refractory materials.

[0006]

[Actual Examples]

The present invention will now be explained in more detail with the use of actual examples. Table 1 shows the evaluation results for test materials coated with coating materials with compositions according to Actual Examples 1 to 8 and Comparison Examples 1 to 8.

[0007]

[Actual Example 1] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than 43 µm, 30 weight% of alumina with a grain size of less than 150 µm obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece

of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 50°C . The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at $1,300^\circ\text{C}$.

[0008]

[Actual Example 2] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than $43 \mu\text{m}$, 30 weight% of alumina obtained by the Baeyer method with a grain size of less than $150 \mu\text{m}$, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 160°C . The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at $1,300^\circ\text{C}$.

[0009]

[Actual Example 3] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than $43 \mu\text{m}$, 30 weight% of alumina with a grain size of less than $150 \mu\text{m}$ obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like

mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring 400 × 350 × 10 mm that had been preheated to 200°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0010]

[Actual Example 4] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 95 weight% of alumina with a grain size of less than 150 µm obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring 400 × 350 × 10 mm that had been preheated to 140°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0011]

[Comparison Example 1] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than 43 µm, 30 weight% of alumina with a grain size of less than 150 µm obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of

water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 40°C . The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with a thickness greater than 0.2 mm could not be achieved. The coating with a thickness of only 0.2 mm showed fusion with to-be-fired material after being used 5 times in a pottery firing process at $1,300^{\circ}\text{C}$. Peeling of the coating could be detected after the coated product was used only once.

[0012]

[Comparison Example 2] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than $43 \mu\text{m}$, 30 weight% of alumina with a grain size of less than $150 \mu\text{m}$ obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with a thickness greater than 0.2 mm could not be achieved. The coating with a thickness of only 0.2 mm showed fusion with to-be-fired material after being used 5 times in a pottery firing process at $1,300^{\circ}\text{C}$.

Peeling of the coating could be detected after the coated product was used only once.

[0013]

[Comparison Example 3] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than 43 μm , 30 weight% of alumina with a grain size of less than 150 μm obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a brush onto the surface of a silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with thickness greater than 0.2 mm could not be achieved. The coating with a thickness of only 0.2 mm showed fusion with to-be-fired material after being used 3 times in a pottery firing process at 1,300°C.

Peeling of the coating could be detected after the coated product was used only once.

[0014]

[Comparison Example 4] 1.5 weight% of wax emulsion as an organic binder was added to a mixture consisting of 65 weight% of synthetic mullite with a grain size of less than 43 μm , 30 weight% of alumina with a grain size of less than 150 μm obtained by the Baeyer method, 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm

that had been preheated to 220°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 1.0 mm at normal temperature; a coating with thickness greater than 1.0 mm could not be achieved. The external appearance of the coating showed blemishes due to overheating of the refractory material or blemishes due to sudden boiling of the coating. Peeling of the coating could be detected after the coated product was used only once in a pottery firing process at 1,300°C.

[0015]

[Actual Example 5] 0.3 weight% of PVA as an organic binder was added to a mixture consisting of 70 weight% of sintered alumina with a grain size of less than 150 µm, 25 weight% of alumina with a grain size of less than 150 µm obtained by the Baeyer method, 5 weight% of silica sand, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring 400 × 350 × 10 mm that had been preheated to 160°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0016]

[Actual Example 6] 0.5 weight% of an organic dispersion agent and 0.3 weight% of CMC as an organic binder were added to a mixture consisting of 100 weight% of alumina with a grain size of less than 20 µm obtained by the Baeyer method

and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 160°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0017]

[Actual Example 7] 0.3 weight% of PVA as an organic binder was added to a mixture consisting of 95 weight% of synthetic mullite with a grain size of less than 43 μm , 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 160°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0018]

[Actual Example 8] 0.3 weight% of CMC as an organic binder was added to a mixture consisting of 65 weight% of sintered alumina with a grain size of less than 150 μm , 30 weight% of alumina with a grain size of less than 150 μm obtained by the Baeyer

method, 2 weight% of silica sand, 3 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm that had been preheated to 160°C. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed no peeling of the coating at normal temperature. It also showed no fusion with to-be-fired material or peeling of the coating after being used 50 times in a pottery firing process at 1,300°C.

[0019]

[Comparison Example 5] 0.3 weight% of PVA as an organic binder was added to a mixture consisting of 70 weight% of sintered alumina with a grain size of less than 150 μm , 25 weight% of alumina with a grain size of less than 150 μm obtained by the Baeyer method, 5 weight% of silica sand, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with thickness greater than 0.2 mm could not be achieved. This coating with a thickness of 0.2 mm showed fusion with to-be-fired material after being used only once in a pottery firing process at 1,300°C. Peeling of the coating occurred after the coated product was used only once.

[0020]

[Comparison Example 6] 0.5 weight% of an organic dispersion agent and 0.3 weight% of CMC as an organic binder were added to a mixture consisting of 100 weight% of alumina with a grain size of less than 20 μm obtained by the Baeyer method and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with a thickness greater than 0.2 mm could not be achieved. This coating with a thickness of 0.2 mm showed fusion with to-be-fired material after being used only once in a pottery firing process at $1,300^\circ\text{C}$. Peeling of the coating occurred after the coated product was used only once.

[0021]

[Comparison Example 7] 0.3 weight% of PVA as an organic binder was added to a mixture consisting of 95 weight% of synthetic mullite with a grain size of less than 43 μm , 4 weight% of silica sand, 1 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring $400 \times 350 \times 10$ mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with a thickness greater than 0.2

mm could not be achieved. This coating with a thickness of 0.2 mm showed fusion with to-be-fired material after being used only once in a pottery firing process at 1,300°C. Peeling of the coating occurred after the coated product was used only once.

[0022]

[Comparison Example 8] 0.3 weight% of CMC as an organic binder was added to a mixture consisting of 65 weight% of sintered alumina with a grain size of less than 150 µm, 30 weight% of alumina with a grain size of less than 150 µm obtained by the Baeyer method, 2 weight% of silica sand, 3 weight% of clay, and 100 weight% of water. The constituents were mixed in a ball mill to form a slurry-like mixture. This slurry-like mixture was sprayed uniformly with the use of a spray nozzle onto the surface of a piece of silicon carbide siliceous refractory material measuring 400 × 350 × 10 mm at normal temperature. The coated silicon carbide siliceous refractory material was then dried to obtain a test material. This test material showed partial peeling of a coating with a thickness of 0.2 mm at normal temperature; a coating with a thickness greater than 0.2 mm could not be achieved. This coating with a thickness of 0.2 mm showed fusion with to-be-fired material after being used only once in a pottery firing process at 1,300°C. Peeling of the coating occurred after the coated product was used only once.

[0023]

[Table 1] [see next page -- Tr. Ed.]

TABLE 1. KEY: (a) weight%; (b) Actual Example; (c) Comparison Example; (d) composition, synthetic mullite (less than 43 µm); (e) alumina by the Baeyer method (less than 150 µm); (f) silica sand; (g) clay; (h) organic binder, wax emulsion; (i) water; (j) method of application; (k) heating temperature, °C; (l) coating, number of times used; (m) thickness, mm; (n) surface roughness, µm; (o) peeling at normal temperature; (p) external appearance; (q) fusion; (r) peeling; (s) coloring; (t) spray; (u) brush; (v) normal temperature; (w) no; (x) yes; (y) times; (z) no; (A) yes; (B) good; and (C) blemishes present.

	(b) 実例				(c) 比較例				(a) %
(d)	1	2	3	4	1	2	3	4	
(e) 合成ムライト (43 µm 以下)	65	65	65	0	65	65	65	65	
(e) バイヤー法アルミナ (150 µm 以下)	30	30	30	35	30	30	30	30	
(f) 砂	4	4	4	4	4	4	4	4	
(g) 粘土	1	1	1	1	1	1	1	1	
(h) 有機バインダー ワックスエマルジョン 1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
(i) 水	100 (t)	100	100	100	100	100	100	100 (u)	
(j) 施工方法	スプレー	スプレー	スプレー	スプレー	スプレー	スプレー	スプレー	スプレー	
(k) 加熱温度 (°C)	50	100	200	140	40	50	50	220	
(l) コーティング 施工回数	4	3	3	2	1	1	1	3	
(m) 厚み (mm)	0.1	0.6	0.9	0.5	0.2	0.2	0.2	1.2	
(n) 表面粗さ (µm)	50	100	300	150	30	30	30	500	
(o) 常温剥離	(w)	なし	なし	なし	(x)	あり	あり	あり	
(p) 外観	(B)	良好	良好	良好	(y)	ムラあり	ムラあり	ムラあり	焼け
(q) 融着	1300°C	50回	50回	50回	5回	5回	5回	20回	
(r) 融着	(y)	なし	なし	なし	あり	あり	あり	あり	
(s) 着色	50回	50回	50回	50回	1回	1回	1回	1回	
	なし	なし	なし	なし	なし	なし	なし	なし	

[0024]

[Table 2] [see next page -- Tr. Ed.]

TABLE 2. KEY: (a) weight%; (b) Actual Example; (c) Comparison Example; (d) composition, synthetic mullite (less than 43 µm); (e) sintered alumina (less than 150 µm); (f) alumina by the Baeyer method (less than 150 µm); (g) less than ; (h) silica sand; (i) clay; (j) organic dispersing agent; (k) organic binder; (l) water; (m) method of application; (n) heating temperature; (o) coating, number of times used; (p) thickness, mm; (q) surface roughness, µm; (r) peeling at normal temperature; (s) external appearance; (t) fusion; (u) peeling; (v) coloring; (w) spray; (x) normal temperature; (y) no; (z) yes; (A) good; (B) blemishes present; (C) times; (D) no; and (E) yes.

	(b)			(c)			(a)		
	5	6	7	8	5	6	7	8	
(d) 成分 合成ムライト (43 µm 以下)				85				85	
(e) 濃縮アルミナ (150 µm 以下)									
(f) バイヤー法アルミナ (150 µm 以下)	10				65	70			65
(g) (150 µm 以下)	25				30	25			30
(h) 粘土 (20 µm 以下)	100					100			
(i) 粘土	5	0	4	2	5	0	4	2	
(j) 有機分散剤	0	0	1	3	0	0	1	3	
(k) 有機バインダー CMC		0.3		0.3		0.3		0.3	
(l) 水 (w)	0.3	100	100	100	0.3	100	100	100	
(m) 施工方法 (スプレー)		スプレー							
(n) 加熱温度 (°C)	100	100	100	100	常温	常温	常温	常温	
(o) コーティング 施工回数	2	3	3	2	1	2	1	1	
(p) 厚み (mm)	0.4	0.2	0.8	0.5	0.2	0.2	0.2	0.2	
(q) 表面粗さ (µm)	400	50	100	180	30	30	30	30	
(r) 常温剥離 (T)	(y)	なし	なし	なし	あり	あり	あり	あり	
(s) 外観 (良)	良	良	良	良	ムラあり	ムラあり	ムラあり	ムラあり	
(t) 融着 1300°C	50回	50回	50回	50回	1回	1回	1回	1回	
(u) 剥離 50回	なし	なし	なし	なし	あり	あり	あり	あり	
(v) 着色	なし	なし	なし	なし	なし	なし	なし	なし	

[0025]

[Effect of the Invention] As mentioned above, if the characteristics of the coating material of the present invention are utilized to enhance the effect of preventing

the reaction and fusion of the refractory coating material and a to-be-fired substance, the service life of the refractory material can be prolonged and it will become possible to sharply reduce the costs after firing.